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13. ABSTRACT (Maximum 200 words) Special instrumentation is required to measure and analyze laser pulses below one nanosecond because of the limitations of standard instrumentation used to measure real-time signals. We have designed and developed an instrument with unique features to measure the pulsewidth of single laser pulses below one nanosecond using the standard autocorrelation technique. A single laser pulse is divided into two equal pulses by a 50/50 beamsplitter and recombined in space and in time inside a wafer of KDP crystal which generates a second harmonic of each fundamental pulse and a second harmonic of the combined pulses. These three pulses are then focused on a charge-coupled device (CCD) camera and analyzed by a laser beam analyzer to yield information on the FWHM (full-width-half-maximum) time of the original pulse. By using a CCD camera the full two-dimensional image can be recorded to insure that the correct horizontal profile is analyzed within the vertical profile. The delay for overlapping the beams in time is obtained by translating the beamsplitter while the positioning is obtained by rotating the beamsplitter. The design and results are discussed.				
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profile of the original pulse. A charge-coupled device (CCD camera, Cohu Model 4800) records the spatial image by integrating the time history of the second harmonic generated in the KDP crystal.

B. Design

This autocorrelator was designed to operate with wavelengths between 532 and 580 nm and for pulsewidths as short as 50 fs. The KDP crystal was fabricated to our specifications of 30 mm in diameter, 300 micrometers (μm) in thickness, and cut with an angle between 68 and 82 deg. The actual usable diameter is 28 mm, and the KDP crystal is mounted with a 1-mm-thick sapphire window in front and an ultraviolet filter (Schott Glass, UG-11) behind to block the fundamental. As shown in Fig. 1, a 50-mm focal length lens focuses the three beams on the CCD detector in the camera. The camera is the detector of the Beamgrabber laser diagnostic instrument and presents a full two-dimensional image of the three beams on the CRT screen. However, only the horizontal profile contains the autocorrelation information, which is in the plane of the three second harmonic beams propagating from the surface of the KDP crystal. This instrument captures and analyzes the images recorded from a single pulse and presents the data as the width in micrometers of the half-intensity points from the autocorrelation signal. This width is then multiplied by the calibration factor and the form factor to obtain the FWHM pulsewidth.

C. Calibration

The calibration on this instrument is carried out in exactly the same procedure as the classical autocorrelator by

introducing a known calibrated delay in one beam path and recording the translation of the second harmonic image on the camera [4]. The Beamgrabber performs all calculations for this calibration.

III. RESULTS

This single-shot autocorrelator measures individual pulsewidths from laser in the visible wavelengths between 532 and 580 nm and has a calibration factor of 400 μm of translation for a 317-fs delay in one beam. A form factor of 1.414 is used in the calculations for an assumed TEM_{00} pulse profile.

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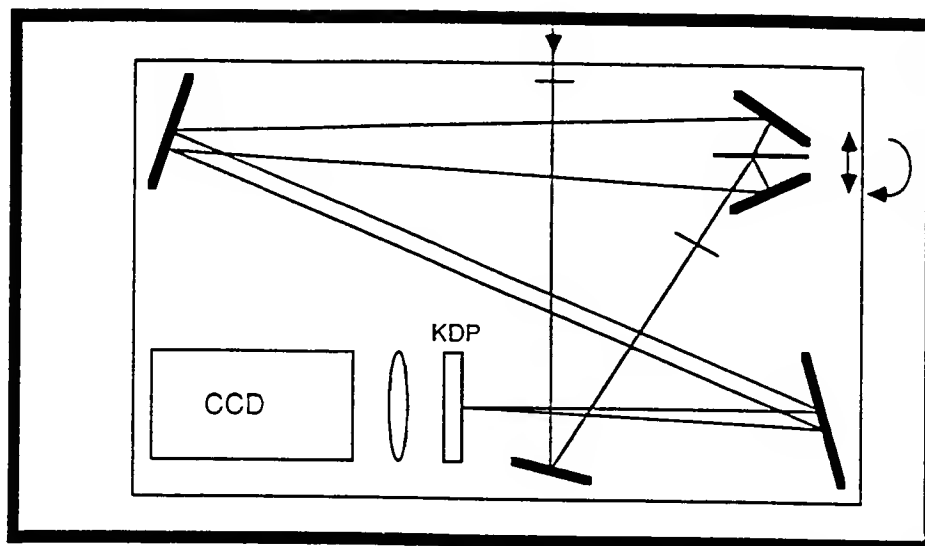


Fig. 1. Single-shot autocorrelator optical layout.